AIRCRAFT SEAT CUSHION REPLACEMENT PROGRAM

Principal Investigator:
Hamid Lankarani
Professor of Mechanical Engineering and NIAR Senior Fellow
National Institute for Aviation Research
Wichita State University
Wichita, KS 67260-0091
Phone: (316) 978-6307, Fax: (316) 978-3236
Email: Lankaran@me.twsu.edu

FAA Technical Monitor/Contacts: Steve Soltis, Gary Frings, Tong Vu
Participants: NIAR/WSU, FAA-TC, FAA-CAMI

The aircraft seat cushion deteriorates with time and they need to be replaced with new ones. This involves a lengthy, time-consuming and costly certification process. The objective of this research was to conduct a series of FAR Part 25.562 Test-I full-scale dynamic seat tests at the Impact Dynamic Laboratory at the National Institute for Aviation Research (NIAR) using different cushions foam in order to validate the AGATE subcomponent seat cushion replacement procedure.

AGATE subcomponent methodology involved utilization of static tests of the energy absorbing foam cushions and validation of design by conducting a full-scale dynamic seat test under Test-1 conditions. Issues including open and close foams cell as well as rate sensitivity were addressed in that program

A series of full-scale dynamic sled tests under Test-I conditions were conducted on various low rate sensitive DAX seat cushion foams with two anthropomorphic test dummies (ATD) placed side-by-side. Later full-scale dynamic sled tests were conducted on the pre-certified industrial cushions and lay-up of various DAX cushion, placed side by side. The purpose of the test was to establish a co-relation between lumbar loads of these foams under similar test conditions. A plot of acceleration pulse and lumbar load with time for the full-scale dynamic sled test was plotted. The lumbar load values for lay-up and pre-certified industrial cushion matched closely.

The load deflection tests were conducted on different pre-certified industrial cushions and build-up (lay-up) foams on an MTS machine at Structures lab, NIAR. A 50 in^2 indentor obtained from Cessna is attached to the crosshead and is used to compress the foam. The indentor is lowered on to the specimen at a specified rate (3.7inch/sec) to a desired compression level (90%). The purpose of this test is to verify that the new foam build-up has equivalent load versus deflection characteristics to the current foam build-up. Hence it is used to characterize the load ñdeflection response of foam material.

The load vs. deflection response of pre-certified and lay up cushion were studied. A dynamic load at the rate of 3.7 in/s was applied on these foams. The maximum load that these cushion

take to compress to approximately 90% of the original thickness was around 2500-3000 lb. The load deflection characteristics of the pre-certified industrial and the normalized lay-up cushions match closely. The variation was observed to be negligible.

A series of dynamic tests will be conducted on part-25 type cushions. In addition to this, full-scale dynamic tests will also be performed on the lay-ups for FAR Part-25 and Part-23. In conjunction with quasi-static and dynamic testing two modeling tools of MADYMO and LS-Dyna are being utilized to build a computer model of the dynamic behavior of cushions. These models will then be validated with the actual tests.